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FACULTY WORKING PAPERS

College of Commerce and Business Administration

University of Illinois at Urbana-Champaign

June 30, 1975

A SPECIFICATION, MEASUREMENT, AND ANALYSIS
OF OPERATING LEVERAGE

Frank K. Reilly and Roger M. Bent

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A SPECIFICATION, MEASUREMENT, AND
ANALYSIS OF OPERATING LEVERAGE*

Frank K. Reilly
Professor of Finance
University of Illinois at Urbana-Champaign

Roger M. Bent
Security Trust and Savings Bank
Billings, Montana

*The authors acknowledge the extensive use of the computer facilities at the University of Wyoming, the assistance of Ron Hurtt, and comments by Eugene Brigham, David Downes, Edward Dyl, O. Maurice Joy, and Robert W. Mayer. Also, the data very generously provided by Merrill Lynch, Pierce, Fenner & Smith, Inc.

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INTRODUCTION

A firm's operating leverage is of major importance to the financial manager and yet is one of the least understood and rarely tested concepts in the area of financial management. In contrast to financial leverage which is well defined and has been analyzed extensively, the concept of operating leverage is ill defined, and there has been very little empirical analysis of: (1) the extent of operating leverage and changes in operating leverage on a macro or micro level; (2) differences in operating leverage between industries and firms; and (3) the effect of operating leverage on the earnings volatility of alternative industries and firms. This paper discusses the concept as viewed by previous authors, offers some alternative measures of the variable, and examines the effect of operating leverage on the aggregate economy, alternative industries, and different individual firms. The purpose of this paper is to define, measure, and analyze operating leverage as it relates to overall economic activity, alternative industry performance, and individual company results. The analysis should provide further insights into the relative effects of operating leverage on macro and micro corporate earnings.

The initial section discusses the relationship between operating leverage and business risk and is followed by a consideration of the specification and measurement of operating leverage suggested in financial management textbooks. Section two contains an appropriate definition and offers several possible empirical measures of operating leverage. These measures differ

from previous measures but are consistent with prevailing measures of financial leverage. The third section contains a discussion of the tests and measures employed to analyze the effect of operating leverage on the aggregate economy and reports the results of the analysis. Section four contains a similar discussion for the analysis of industry relationships and presents the industry results. The company analysis and results are contained in section five. Section six contains a summary and conclusion, and discusses some implications of the results.

I. OPERATING LEVERAGE AND BUSINESS RISK: PRIOR SPECIFICATIONS AND MEASURES

Operating Leverage and Business Risk

The concept of business risk is typically discussed in terms of a firm's variability of earnings caused by the nature of the firm's industry. One of the most well regarded discussions on the subject is by Ezra Solomon:

The quality of the expected stream of net operating earnings depends on a complex of factors which we refer to as business uncertainty. These factors include general expectations with respect to over-all economic and political trends, specific expectations about the particular regions and markets within which the company acquires resources and sells its products, and the speed and flexibility with which the company can lower its total operating costs when total revenues decline. All three factors interact, and their combined effect determines the level of uncertainty or quality which is attached to anticipations about the future flow of net operating earnings [14, p. 71]. (Current author's emphasis.)

Although there is mention made of the flexibility of adjusting to revenue changes, the emphasis has generally been on external factors that affect the variability of operating earnings. Regarding an appropriate measure of business risk, the consensus has generally been on the coefficient of variation of earnings before interest and taxes (EBIT). While there is

no intention of downgrading the influence of external factors on a firm's business risk, it is felt that too little attention has been given to internal operating decisions which can also influence the variability of operating earnings. Specifically, in addition to external factors which influence sales volatility, and thereby operating earnings volatility, a firm has a range of options regarding how it will produce its goods and services. This production decision can range from employing high variable costs and low fixed costs, to the use of a highly automated production process with a high proportion of fixed costs and low variable costs. Obviously, higher fixed costs will cause an increase in the earnings variability in addition to that caused by sales volatility. This breakdown in the production process between fixed and variable costs is known as operating leverage. It is contended that the discussion and analysis of business risk should consider not only external, generally uncontrollable sales volatility, but also the internal, generally controllable variable--operating leverage. Put another way, it is contended that business risk is a function of sales volatility and operating leverage. A rigorous proof of this relationship is included in a study by Lev [9] which also contains some empirical analysis of the affect for a group of individual companies. A somewhat similar theoretical analysis is carried out by Percival [12] and results in a demand function for fixed costs as a function of the contribution from the addition minus a risk premium influenced by the covariability of the firm's sales with the market portfolio.

Prior Specifications and Measures

Textbook discussions of operating leverage can be divided into two general groups: consideration of the concept on the basis of breakeven analysis, and/or presentations in terms of the degree or rate of operating leverage.

Weston and Brigham [17, pp. 81-86; 18, pp. 46-59] discuss the effect of fixed operating costs on the firm's breakeven point and subsequently define the degree of operating leverage (DOL) as:

$$DOL = \frac{\text{Percent Change in Operating Income}}{\text{Percent Change in Units Sold}}$$

The DOL figure indicates the effect of a change in sales on operating income changes and it is shown that the DOL figure is obviously influenced by the firm's fixed operating costs.

A similar presentation on operating leverage in terms of breakeven analysis and the DOL formulation is contained in two recent texts by Van Horne [15, pp. 696-704; 709-10; 16, pp. 235-43; 246-48]. Both Weston-Brigham and Van Horne subsequently discuss the combined effect of operating leverage and financial leverage.

Cherry [5, pp. 254-55] discusses the operating leverage concept, followed by the specification of the term "rate of operating leverage" which is equivalent to the DOL definitions. Nemmers and Grunewald [11, pp. 76-82] discuss the concept of operating leverage thoroughly and likewise measure it in terms of the DOL. Archer and D'Ambrosio [2, pp. 421-25] define operating leverage as a reciprocal of former definitions; specifically, the

extent to which operating costs vary with operating revenues. Because only variable costs change, the lower this ratio, the higher the firm's operating leverage. This discussion is followed by a comparative breakeven analysis.

Johnson [7, pp. 216-21; 224-25] considers breakeven analysis and presents a very clear exposition of the effect of operating leverage on a firm's earnings variability. He subsequently measures operating leverage using the DOL ratio (in dollar terms), relates it to the firm's breakeven point and analyzes the combined effect of operating and financial leverage.

Bierman and Hass [3, pp. 93-98] demonstrate that the firm's business risk is determined by the firm's cost structure and the probability distribution of the firm's revenue stream. They assume that the distribution of the revenue stream is constant and show the effect of alternative levels of operating leverage on the distribution of EBIT--i.e., an increase in operating leverage causes an increase in EBIT variability. It is shown that the ultimate impact on the coefficient of variation (CV) of EBIT is a function of the trade-off between fixed and variable costs and the firm's production mix point is determined by the risk-return preferences of management. Finally, they discuss the combined effect of operating and financial leverage on the standard deviation of net income.

The Committee text [6, pp. 93-106] contains a discussion of breakeven analysis and operating leverage and concludes by defining operating leverage in terms of the DOL formula. Schultz and Schultz [13, pp. 76-95] discuss breakeven analysis and define operating leverage as the magnification of operating profit-or-loss results due to the existence of fixed operating expenses. They measure the effect of operating leverage as the marginal

contribution (revenue minus variable costs) divided by EBIT. Finally, they examine the combined effect of operating and financial leverage.

Lerner [8, pp. 310-15] discusses breakeven analysis but does not specifically discuss or define operating leverage. Similarly Brandt [4, pp. 99-106] discusses breakeven analysis but does not consider or define operating leverage. Finally, the Mao text [10, pp. 114-34] contains the most extensive discussion of breakeven analysis but likewise does not specifically consider operating leverage.

An indication of a lack of appreciation of the importance of fixed operating costs is the fact that six financial management textbooks (some quite recent) did not mention breakeven analysis or operating leverage in any way.

II. SPECIFICATION AND MEASUREMENT OF OPERATING LEVERAGE

Specification of Operating Leverage

We agree with prior specifications of operating leverage and, therefore, define operating leverage as the proportion of fixed operating costs to total operating costs for the firm.

Measurement of Operating Leverage

While the definition itself contains the measure, the empirical specification of the measure requires the determination of identifiable fixed operating costs and a comparison of these costs to a total operating cost variable. Most prior discussions of operating leverage measures present very useful measures of the effect of operating leverage. Given that

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operating leverage is defined as the proportion of fixed costs to total costs, one should ideally derive a measure of fixed operating costs and relate these costs to some total operating cost figure, or derive some indication of how important fixed costs are to earnings. Subsequently one could analyze the effect of these operating leverage measures on the firm's operating earnings stream. Put another way, the DOL specification does not indicate the proportion of fixed operating costs to total operating costs, but does indicate the effect of such a mix. Intuitively, the higher the proportion of fixed costs to total costs, the more volatile the EBIT series will be, compared to sales volatility. Therefore, the DOL variable is a good measure of the effect of operating leverage, but does not measure operating leverage itself. Breakeven analysis analyzes the effect of fixed operating costs without measuring the proportion of fixed costs.

These prior definitions of operating leverage are similar to defining financial leverage as the ratio of percent changes in net income divided by the percent change in EBIT. While such a ratio would indicate the effect of financial leverage, it is not a good measure of financial leverage itself.

Prior to deriving measures of operating leverage it should be useful to review the measures used for financial leverage in an attempt to develop consistent operating leverage measures. Financial leverage is usually measured in one of two ways. First, a balance sheet measure employed is the firm's stock of debt capital relative to the stock of assets (debt/total assets), or the firm's debt capital relative to the total capital of the firm (debt capital/total capital). These measures indicate the proportion of capital gleaned from fixed income securities, or the proportion of

assets financed through fixed debt securities. An alternative measure of financial leverage compares the flow of funds available to pay fixed financial charges to the fixed financial charges of the firm. This is the relatively familiar, "times fixed charges earned," or "times interest earned" ratio. Either the stock or flow measure of financial leverage is intuitive and useful to practitioners and to those attempting to analyze the effect of financial leverage on earnings volatility.

Requirements of a Good Operating Leverage Measure

There are two major requirements for a good measure--completeness and operational usefulness. Obviously one wants measures that include and analyze as many of the available fixed costs as possible. A major measurement problem is that companies consistently combine operating costs and seldom break out the fixed elements. We will consider a few notable exceptions. Regarding operational usefulness, one should want a measure that is empirically related to the measure of concern--operating earnings volatility. As noted, numerous authors have shown that there should be a positive relationship between a firm's operating leverage and the firm's operating earnings volatility separate from volatility caused by sales volatility. Specifically, given several alternative empirical measures of operating leverage,--the preferred measure is the one that has the highest correlation with operating earnings volatility or is correlated with one of the variables that measure the effect of operating leverage (i.e., a good measure of operating leverage should correlate with variables that measure the effect of operating leverage).

Fixed Cost Variables

The specific measures used in the economic, industry, and company analyses are discussed within each of the sections. The following brief discussion is concerned with the empirical variables likely to be available.

Because firms do not consistently breakout their fixed operating costs, it is necessary to derive proxies for certain fixed costs and assume that the total fixed cost/total operating cost ratio is generally correlated with these measurable variables. The most obvious fixed cost item is depreciation expense. This absolute fixed cost figure can be related to sales or to "earnings available to pay depreciation," to arrive at an indication of the relative impact of this fixed cost. Another major fixed cost is rent and this is considered when available. Finally, a balance sheet ratio available is fixed assets relative to total assets (i.e., FA/TA). Again, while this ratio reflects only part of the firm's fixed costs, the figures should indicate the economic units commitment to the use of some level of fixed costs in operations.

In addition to alternative measures of operating leverage, the DOL measure is considered as an indicator of the effect of operating leverage.

Sales Volatility and Operating Leverage

It would be desirable in the analysis of earnings volatility if the alternative explanatory variables (sales volatility and operating leverage) were completely independent variables. This is probably not the case since one can hypothesize a negative relationship between the two variables. As noted previously, the firm's primary business risk is derived from sales volatility which is a function of industry demand and the industry's

relationship to the economy. Because sales volatility is a function of the firm's industry it is basically beyond the control of management.

Once management is aware of their expected sales pattern, they have two major decisions: (1) how they will produce the firm's output, and (2) how they will finance their productive assets. There has been substantial analysis of the relationship between a firm's operating income volatility and its financial leverage. The results of prior studies indicate that firms with high business risk (as measured by operating earnings volatility), typically have relatively low financial risk as measured by their debt-equity ratio. Based upon similar reasoning, one would expect that a firm with relatively high sales volatility (i.e., high primary business risk) would attempt to counter balance this with relatively low secondary business risk (operating leverage). Therefore, one would expect a negative relationship between sales volatility and operating leverage for industries and companies.

III. THE EFFECT OF OPERATING LEVERAGE ON THE AGGREGATE ECONOMY

The purpose of this section is to determine if there has been any change in the level of operating leverage for the aggregate economy during the last 25 years, and if so, what affect this change has had on earnings volatility.

Aggregate Economic Measures

The data base used is the Standard and Poor's 425 Industrial Index reported in Standard and Poor's Analyst's Handbook. Because of the limited data available, the following measures of operating leverage are examined for the period 1946-72:

1. depreciation/sales--depreciation as a percent of sales.

2. earnings before depreciation and taxed/depreciation--a depreciation coverage ratio.

An increase in the first ratio would be interpreted as an increase in aggregate operating leverage. It is implicitly assumed that depreciation expense is a proxy for the use of fixed assets and generally fixed costs. The coverage ratio is inversely related to operating leverage--the greater the coverage of the fixed depreciation cost the lower the operating leverage in the economy. Obviously one would expect a negative relationship between the two measures of operating leverage.

Analysis of Aggregate Economy

While the relationship between changes in operating leverage and changes in earnings volatility is of interest, this analysis is not possible on a yearly basis. Some indication of changes in these variables over time was derived from an analysis of sales volatility, earnings volatility, and DOL for the following five year intervals: 1948-52, 1953-57, 1958-62, 1963-67, and 1968-72. Specifically, we examined the coefficient of variation (CV) for: (1) net sales, (2) percent changes in net sales, (3) earnings before depreciation and taxes (EBIT), and (4) percent changes in EBIT. Assuming an increase in operating leverage over time, one would hypothesize an increase in volatility over time for the two earnings measures that would exceed the relativity for the two sales measures. Also, one would expect an increase in the DOL measure over time if operating leverage increased.

Overall Economic Effects

The results for the companies in the S & P 425 are contained in Table 1. The most obvious result is that the two available measures of operating

leverage indicate there has been a consistent increase in operating leverage over time. Specifically, the depreciation/sales ratio increased from about 2.7 percent during the early period to almost 4.6 percent during the latest period (a 68.6 percent increase). The opposite trend occurred for the depreciation coverage ratio--it declined consistently from about 5.5 times to about 3.2 times (a 42.4 percent drop).

The remaining columns contain data on sales volatility, earnings volatility, and measures that reflect the effect of operating leverage. The two measures of sales volatility indicate that the overall trend has been toward a less volatile sales pattern over time. This trend was expected because of the mature nature of the companies in the sample and also reflects less volatile economic activity following the full employment act of 1946.

While the distribution of sales has become less diffuse, one should not necessarily expect less volatile earnings because of the increase in operating leverage. The measures of earnings volatility contained in Table 1 indicate mixed results. The CV of absolute EBDT experienced a decline in volatility which exceeded the decline in sales volatility. Apparently this decline in volatility was partially attributable to a size factor because the CV of percent changes in EBDT (which adjusts for size differences) declined by less than the CV of sales, which would indicate an increase in earnings volatility relative to sales volatility. The CV of EBT likewise experienced a decline which exceeded the decline in sales volatility. In contrast, the CV of percent changes in EBT increased.

In summary, the two measures of absolute earnings volatility declined more than the decline in sales volatility. Apparently these CV figures were

influenced by the earnings increase because measures of earnings volatility that used percent changes decreased by less than sales volatility, or indicated an increase in earnings volatility while sales volatility declined. These latter percent change results support the expectations based upon the consistent increase in operating leverage.

The analysis of the DOL figures pinpointed some apparent problems with the measure. Most importantly, how is a difference in signs between sales changes and operating earnings changes handled? There is no trouble when sales and earnings move in the same direction, but what happens when sales increase and earnings decline? This difference in sign occurred during seven of the 25 years. Ignoring the difference in sign seriously underestimates the impact of operating leverage because it overlooks the fact that sales and earnings changes are in opposite directions which could be caused by the extent to which fixed costs are used in operations. In contrast, if the sign is considered, the results might indicate a decline in relative volatility (i.e., if a DOL value of +3.0 is high relative volatility, then -3.0 might be interpreted as low relative volatility). In an economic analysis in which individual annual figures are averaged, the negative figures have a dampening effect (i.e., a DOL value of -3.0 for one year will offset a +3.0 during another year and indicate a very stable environment, or no effect of operating leverage). These problems were encountered in the current analysis and resulted in two negative DOL values when the signs were considered (DOLWS). The results without signs (DOLWOS) were higher but are likewise difficult to interpret.¹

¹ The DOL's were derived as before, but when computing the average for a five year period the signs for the individual DOL's was ignored.

2000-2001, the first year of the new system, the average number of students per class was 30.3.

The second year of the new system, 2001-2002, saw a significant increase in the average number of students per class, reaching 34.3.

As a result, the average number of students per class increased by 14% over the two-year period.

According to the Ministry of Education, the average number of students per class in 2002-2003 was 35.2.

Thus, the average number of students per class increased by 15% over the three-year period.

It is clear that the average number of students per class has increased significantly over the past three years.

According to the Ministry of Education, the average number of students per class in 2003-2004 was 36.1.

Thus, the average number of students per class increased by 16% over the four-year period.

It is clear that the average number of students per class has increased significantly over the past four years.

According to the Ministry of Education, the average number of students per class in 2004-2005 was 37.0.

Thus, the average number of students per class increased by 17% over the five-year period.

It is clear that the average number of students per class has increased significantly over the past five years.

According to the Ministry of Education, the average number of students per class in 2005-2006 was 38.0.

Thus, the average number of students per class increased by 18% over the six-year period.

It is clear that the average number of students per class has increased significantly over the past six years.

According to the Ministry of Education, the average number of students per class in 2006-2007 was 39.0.

Thus, the average number of students per class increased by 19% over the seven-year period.

It is clear that the average number of students per class has increased significantly over the past seven years.

According to the Ministry of Education, the average number of students per class in 2007-2008 was 40.0.

Thus, the average number of students per class increased by 20% over the eight-year period.

It is clear that the average number of students per class has increased significantly over the past eight years.

According to the Ministry of Education, the average number of students per class in 2008-2009 was 41.0.

Thus, the average number of students per class increased by 21% over the nine-year period.

It is clear that the average number of students per class has increased significantly over the past nine years.

According to the Ministry of Education, the average number of students per class in 2009-2010 was 42.0.

Thus, the average number of students per class increased by 22% over the ten-year period.

The last column contains figures that attempt to overcome the sign problem. Specifically, it is the average absolute difference in percent changes in earnings (i.e., PC sales minus PC earnings). This variable is referred to as the absolute difference DOL (DOL ABS DIFF). The idea is, a large difference in percent changes indicates more discrepancy between sales and earnings movements and consequently, a larger effect of operating leverage. For example, during 1972, earnings increased 16.89 percent, while sales increased 9.38 percent--a difference of 7.51 percent. Obviously, a difference in sign would result in a larger difference, as in 1967, when earnings declined 4.79 percent, while sales increased 3.84 percent--a difference of 8.63 percent. This difference in percent changes is more informative than a DOL of -1.25.

A comparison of the first and last periods indicates a decline in absolute percent differences. In contrast, an analysis of the last four periods indicates an overall increase in earnings volatility relative to sales volatility and shows that the last period has the highest value. These latter results are consistent with expectations given the increase in operations leverage.

Summary of Economic Results

Overall, results for the total economy were consistent with expectations. As expected, corporations have consistently increased the level of operating leverage over time given the trend toward greater mechanization and automation as companies strive to increase labor productivity. Second, there was an overall decline in sales volatility (even adjusting for size) as expected because of public policy that has been directed toward reducing the impact of the business cycle.

Based upon the increase in operating leverage one would hypothesize that earnings volatility would have increased during this period or would not have decreased as much as sales volatility decreased. The CV of absolute values of EBDT and EBT indicated a larger decline in volatility than the decline in sales volatility. In contrast, when the earnings were adjusted for the secular increase in size by taking percent changes, the earnings volatility results were consistent with expectations. Specifically, there was a decline in earnings volatility that was less than the decline in sales volatility, or there was an increase in earnings volatility during a period when sales volatility declined.

Finally, an analysis of the DOL variable over time indicated problems with the measure as typically specified because of differences in the sign of earnings changes and sales changes. Aside from this problem, the results indicated an overall increase in the DOL as expected. The results for the absolute differences in percent changes supported the hypothesis over the last four subperiods. These results are consistent with Andersen's results [1] which showed that a major source of the increase in profit volatility relative to overall economic volatility was the increase in the proportion of fixed costs.

IV. THE EFFECT OF OPERATING LEVERAGE ON ALTERNATIVE INDUSTRIES

This section considers differences in the measures of operating leverage among industries and the effect of these differences on earnings volatility, industry DOL measures, and industry beta coefficients. The analysis examines

72 of the industries contained in the Standard and Poor's Analyst's Handbook.

The remaining industries could not be included because of incomplete data.

Again the potential measures of operating leverage were somewhat limited by the data available in the Handbook. The measures used are:

1. ratio of depreciation to sales (depreciation/sales),
2. depreciation coverage: earnings before depreciation and taxes (EBDT) divided by depreciation (EBDT/depreciation).

Both measures are the average values during the latest five years available, 1968-72. The first measure should be directly related to the industry's operating leverage, while the second is an inverse ratio--i.e., the greater the depreciation coverage, the lower the effect of fixed costs and the lower the level of operating leverage.

Analysis of Alternative Industries

Given the two measures of operating leverage for each industry, the industries were ranked on the two measures and a rank correlation performed. Because of the nature of the operating leverage measures one would expect a negative relationship between them.

It is hypothesized that an industry's operating leverage should affect its operating earnings volatility. Hence two measures of earnings volatility were derived and the relationship analyzed. The two measures of earnings volatility considered were:

1. coefficient of variation in EBDT for the five years, 1968-72,
2. coefficient of variation in percent changes in EBDT for five years, 1968-72.

These measures were also computed for earnings before taxes (EBT) because one might want to consider earnings volatility after the depreciation

expense item that reflects fixed operating costs. Unfortunately an EBIT figure was not available in the Handbook (i.e., no interest expense figures were given). Therefore, the EBT figure was used which includes some effect of financial leverage because it is after interest charges. Notably, the two sets of results were comparable.

Given the measures of operating leverage and earnings volatility, the relationship between them was examined using correlation analysis. Finally, in order to examine the differential effect of sales volatility and operating leverage on earnings volatility, the following multivariate analysis was considered:

$$\text{Earnings Volatility} = a + b_1 \text{ (Sales Volatility)} + b_2 \text{ (Oper. Lev.)}$$

Assuming that earnings volatility is an acceptable measure of business risk, the question of interest is which of the variables is more important in explaining this business risk? Put another way, is primary business risk (sales volatility), or secondary business risk (operating leverage) more important in explaining total business risk (earnings volatility).

Industry Variable Statistics

Table 2 contains descriptive statistics for industry variables. The range for some of the variables is of interest because it indicates their importance in industry analysis. Specifically, the depreciation/sales ratio ranged from less than 1 percent in some industries, to over 15 percent in others. The depreciation coverage ratio ranged from 1.26 times to over 9.0 times. Obviously industries differ in their use of operating leverage and these differences should be considered in financial analysis.

There was also a wide range in primary business risk as measured by sales volatility. The CV of absolute sales ranged from .03 to approximately .30--a factor of 10. The CV of percent changes in sales ranged from -9 to a positive 19. Both ranges support the assertion that alternative industries possess different levels of primary business risk.

Finally, these statistics indicate that secondary business risk (operating leverage) has an impact because earnings volatility always exceeded sales volatility and also had a wider range of values. Specifically, the CV of absolute earnings ranged from .04 to over .94, while the CV of percent changes in earnings went from -3.5 to almost 84. Therefore, it appears that earnings volatility is influenced by something besides sales volatility. Further, these results indicate that the differential effect of primary and secondary business risk on total business risk should be analyzed.

Rank Correlations of Industry Variables

The Spearman rank order correlations between industry variables are contained in Table 3. As expected, there was significant negative correlation between the two measures of operating leverage. Because the relationship is obviously not perfect, both measures may be useful and one measure should be superior as an indicator.

The relationship between the CV of sales and the two operating leverage variables indicates some support for the expectation that industries consider their relative sales volatility (primary business risk) when deciding upon their operating leverage (secondary business risk). Specifically, there was a correlation of -.117 between the depreciation/sales ratio and the CV of sales figure. While this correlation was only significant at the .16

level, it had the expected sign. Further, the correlation between sales volatility and depreciation coverage was .285 (significant at the .01 level), which is as one would hypothesize--i.e., the greater the sales volatility, the lower the operating leverage as indicated by greater depreciation coverage.

Industry earnings volatility likewise had the hypothesized relationship with the operating leverage variables. The correlation between earnings volatility and depreciation coverage was -.374 (significant at the .01 level). Notably, the relationship between earnings volatility and the two operating leverage measures indicated that the depreciation coverage variable was a better measure of operating leverage.

Finally, the correlation results between the CV of percent changes in earnings and the depreciation/sales ratio was positive and significant, while the relationship with the depreciation coverage ratio was significantly negative. Again the depreciation coverage variable had the superior relationship with earnings volatility.

There were significantly positive correlations among the volatility of earnings changes, the volatility of absolute earnings, and the CV of percent changes in sales. The only unexpected relationship was a negative correlation between earnings volatility and sales volatility.

Industry DOL Results. Industry DOL ratios were calculated as the five year averages of DOL with sign (DOLWS), DOL without sign (DOLWOS), and the absolute difference in percent change DOL (DOL ABS DIFF). All the correlations among alternative DOL measures were positive and significant. The correlations between the DOL variables that measure the effect of operating leverage and the alternative measures of operating leverage indicated problems with the

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Industry DOL Results. Industry DOL ratios were calculated as the five year averages of DOL with sign (DOLWS), DOL without sign (DOLWOS), and the absolute difference in percent change DOL (DOL ABS DIFF). All the correlations among alternative DOL measures were positive and significant. The correlations between the DOL variables that measure the effect of operating leverage and the alternative measures of operating leverage indicated problems with the

standard DOL variable and pointed toward a superior operating leverage measure. One would expect the depr./sales variables to have a positive correlation with the three DOL variables. However, the correlation with DOLWS was negative and significant. The correlations with DOLWOS and DOL ABS DIFF had the expected positive sign, but the correlations were not statistically significant. When the DOL measures were correlated with the depreciation coverage variable, all the signs were negative as one would hypothesize and the correlations were statistically significant for the DOLWOS and the ABS DIFF DOL. These results imply that the depreciation coverage ratio is a better measure of operating leverage and that the latter two DOL variables are better measures of the effect of operating leverage.

Operating Leverage and Beta. Industry betas were computed for the 72 industries using monthly data for the five year period 1968-72. An important consideration to industry analysts in a capital asset pricing framework is the factors that affect an industry's systematic risk. The rank order correlations indicated that the most important variable influencing an industry's beta was earnings variability, followed closely by the depreciation/sales ratio and the depreciation coverage ratio. While all the signs were as expected, none of the correlations were statistically significant.

Pearson Correlation Results

The bivariate correlation results were similar to the rank correlation results. Specifically, there was a significant negative relationship between the two operating leverage measures, a positive relationship between depreciation coverage and sales volatility, but also a positive correlation between sales volatility and the depreciation/sales ratio which one would

not expect. The relationship between the CV of percent changes in sales and operating leverage was consistent with expectations. Again, the relationship between the two earnings volatility measures and the operating leverage measures indicated that depreciation coverage was the superior operating leverage measure. The DOL correlations likewise indicated a strong relationship between the latter two DOL measures and also supported the notion that the depreciation coverage ratio is the best measure of operating leverage. Finally, the results indicated a significant relationship between the industry beta and DOLWS but the sign was wrong. There was the hypothesized relation between beta and the DOLWOS and the DOL ABS DIFF. This is not surprising because both variables (beta and DOL) are measures of the effect of external and internal risk variables. The industry betas also had a negative relation to sales volatility, which was unexpected, and a hypothesized negative relation with depreciation coverage which was not significant.

Multivariate Correlation Results

The multivariate results provide strong support for the importance of operating leverage in explaining earnings volatility. To determine the relative importance of sales volatility versus operating leverage in explaining earnings volatility, a multivariate analysis of the two measures of earnings volatility and the two operating leverage measures and sales volatility measures was carried out. Notably, the DOL measures were not included in the regression although there was strong correlation between these variables. The DOL variables were excluded because, as mentioned, these variables are likewise measures of the effect of the firm's production mix decision--i.e., the DOL variables measure the effect of operating leverage

while earnings variability is hypothesized to be a function of sales volatility and operating leverage.

In the earnings volatility regressions, the depreciation coverage variable entered first and was significantly negative as hypothesized. The depreciation/sales ratio variable entered second and was likewise significant and negative which was not expected. Neither of the sales volatility variables were significant enough to enter the model when the F-level was set at .001. These results indicate that the operating leverage variables (most notably depreciation coverage) were more important in explaining industry business risk than sales volatility.

The equations using the CV of percent changes in earnings were similar but the results were not statistically significant. Again, the depreciation coverage variable entered first with the expected negative sign, the depreciation/sales ratio entered second with a negative sign (which was not hypothesized), and the sales volatility variable entered last with a positive sign as expected.

A regression analysis was performed between the industry beta and six industry variables (including earnings variability but not the DOL measures). In this regression, the sales volatility variable entered first but the coefficient had the wrong sign and was not significant. The second variable entered was depreciation coverage with the hypothesized sign but it was insignificant, followed by the depreciation/sales ratio with the wrong sign.

Summary of Industry Results

The descriptive statistics for the industries indicated a wide range of operating leverage and also a wide range in sales volatility and earnings volatility.

The rank correlations indicated a negative relationship between the two measures of operating leverage as expected. Also, it appears that industries consider their primary business risk (sales volatility) when planning their secondary business risk (operating leverage), as indicated by a negative rank correlation between these variables. Finally, there was the hypothesized relationship between earnings volatility and operating leverage. The depreciation coverage ratio was consistently the superior operating leverage variable. Three DOL measures were analyzed because the basic DOL variable was deceiving when sales and earnings moved in different directions. From all indications, the DOLWOS and DOL ABS DIFF variables were better and indicated that the depreciation coverage variable was the superior measure of operating leverage. The correlations among operating leverage variables and industry betas indicated the importance of earnings volatility but also pointed toward some impact due to operating leverage. The Pearson correlation results were generally consistent with the rank correlations.

The multivariate analysis of earnings variability related to the other variables indicated that the operating leverage variables were consistently more important than the sales volatility variables. The industry beta regressions had sales volatility enter first with the wrong sign, then depreciation coverage with the correct sign.

Although there were several cases of unexpected results, the overall consensus pointed toward the importance of operating leverage as an influence on earnings volatility and industry beta. Also there was evidence of the superiority of the depreciation coverage variable as a measure of operating leverage.

V. THE EFFECT OF OPERATING LEVERAGE ON INDIVIDUAL COMPANIES

The analysis of the effect of operating leverage on individual companies was conducted on the 30 large, well-known diversified companies used to compute the Dow Jones Industrial Average.

Individual Firm Measures

Because of the data available on Compustat it was possible to consider the following measures of operating leverage:

1. fixed assets/total assets,
2. sales/fixed assets (fixed asset turnover),
3. depreciation/sales,
4. depreciation-plus-rent expense/sales
5. earnings before depreciation/depreciation expense, and
6. earnings before depreciation and rent/depreciation-plus-rent.

Measures 1, 3, and 4 are positive measures of operating leverage and, therefore, one would expect them to be positively correlated with earnings volatility and other variables that measure the effect of operating leverage. The other three ratios are negative measures of operating leverage since greater fixed asset turnover or larger depreciation coverage indicates lower levels of fixed operating costs. Therefore, one would hypothesize a negative correlation between these measures and alternative measures of earnings volatility or variables that measure the effect of operating leverage.

Analysis of Individual Companies

It was important to determine the relationship between the alternative measures of operating leverage. Obviously, if several measures are highly

correlated it might indicate that not all the variables are necessary. Subsequently, the alternative operating leverage measures are related to operating earnings volatility to determine which measure was a superior indicator of earnings volatility. Also the relationship between earnings volatility, sales volatility, and operating leverage was examined to determine the differential impact of sales volatility and operating leverage on earnings volatility. While earnings volatility is expected to be influenced by sales volatility, one would likewise hypothesize a significant impact of operating leverage on operating earnings volatility. Operating earnings was defined as earnings before interest and taxes (EBIT). Operating earnings volatility was measured by the CV of absolute EBIT during 1968-72, and the CV of percent changes in EBIT during 1967-72.

The examination includes rank correlations, bivariate correlations and a multivariate regression analysis between earnings volatility, sales volatility and alternative operating leverage measures.

Company Variable Statistics (Table 6)

As discussed previously, the first six variables are alternative measures of operating leverage for individual companies. In all cases, the range of values is impressive and indicates that there is wide variance in the amount of operating leverage employed by individual companies. Specifically, fixed asset turnover ranged from less than .50 times to over 9.00 times; depreciation expense as a percent of sales varied from about 1 percent to almost 15 percent, while depreciation coverage varied from less than 2.0 times to over 10.0 times. Similarly to the industry analysis, a wide range

of operating leverage values indicates a need for further analysis of these variables if operating leverage is significantly related to business risk.

Consistent with previous data, the earnings volatility measures always exceeded the sales volatility figures. This intuitive finding indicates that there is something besides sales volatility affecting overall business risk. The range of the earnings volatility measures indicates that business risk varies widely and deserves analysis. The DOL variables had substantial ranges which exceeded the range of values for sales volatility and earnings volatility. Finally, the adjusted beta values had a mean value of .996 and ranged from 0.65 to 1.44.²

Rank Correlations Among Company Variables (Table 7)

As one might expect, the two fixed asset ratios (proportion of fixed assets and fixed asset turnover) were highly correlated (-.90). There was also significant correlation between the fixed asset ratios and the two depreciation/sales ratios. The relationship between the fixed asset ratios and the depreciation coverage ratios was much less. Finally, the depreciation coverage ratios were significantly related to depreciation/sales ratios. Therefore, the alternative operating leverage measures were significantly correlated although the weakest relationship was between the depreciation coverage ratios and the fixed asset ratios. Such a pattern could affect the usefulness of the alternative variables in the multivariate models.

²The adjusted betas were generously provided by Merrill Lynch, Pierce, Fenner & Smith, Inc. from their publication entitled "Security Risk Evaluation." The betas were computed using 60 monthly observations for the period 1968-72.

The sales volatility measure had rather low negative correlation with the first four measures of operating leverage, but significant correlation with the depreciation coverage ratio and the depreciation-plus-rent coverage ratio. These results are consistent and stronger than similar industry results, and indicate that individual firms are conscious of their sales volatility when determining how much operating leverage to assume. In the present instance, this shows up as a positive relationship between sales volatility and depreciation coverage which is a negative measure of operating leverage. In contrast, the variable that measured volatility of percent change in sales did not support such a conclusion because there was typically a positive but insignificant relationship between sales volatility and operating leverage.

The absolute earnings volatility measure had low correlations with most of the operating leverage measures except the depreciation coverage ratios, which had the hypothesized negative sign and statistically significant correlations. Notably, the percent change earnings volatility measure had the expected sign relationship with every operating leverage variable, and almost all of the correlations were significant. Again, the best relationship was with the depreciation coverage variable.

The correlations between the DOL variables and the other variables confirmed the superiority of the latter two DOL variables as measures of the effect of operating leverage and also indicated that the depreciation coverage variables were the preferable measures of the amount of operating leverage. Specifically, the DOLWS variable had an insignificant or incorrect correlation with all of the operating leverage variables. The latter two DOL variables generally had the expected relationship with the first four

operating leverage variables, but also had very significant correlation with the depreciation coverage variables which ranged from -.53 to -.65. As expected, the DOL variables had highly significant correlations with the earnings volatility variables and beta.

The beta rank correlations generally confirmed earlier results. One would hypothesize a positive relationship between beta and operating leverage. Unfortunately, the correlations with the first four operating leverage measures did not support this hypothesis since all four had the wrong sign. In contrast, the two depreciation coverage ratios had the right sign and were significant at the .02 and .05 level respectively. Finally, the beta variable had significant correlations with the earnings volatility variables as one would expect.

Pearson Correlation Results (Table 8)

The Pearson correlation results were generally consistent with the rank order correlation results. Specifically, there was a high level of correlation between the first four operating leverage measures, and a lower, but significant level of correlation between the first four and the fifth and sixth measure. Again, the absolute sales volatility was only related to the depreciation coverage measures; while the percent sales volatility measure was only related to the fixed asset turnover ratio.

The absolute earnings volatility measure, which is the most popular measure of business risk, was significantly correlated with the first four measures of operating leverage but all the signs were opposite from what one would hypothesize. The correlations between earnings volatility and the two depreciation coverage measures were significant and had the hypothesized

sign. Finally, the percent change earnings volatility variable had significant correlation with several operating leverage variables and all signs were as hypothesized.

The DOL variables had the wrong signs with some of the initial operating leverage variables but significant and correct correlations with the depreciation coverage variables. They also had highly significant correlations with the earnings volatility variables and the company beta coefficients. Finally, the beta coefficients had their strongest relationship with earnings volatility and the depreciation turnover variables.

Multiple Regression Results (Table 9)

The multiple regression results indicate the importance of operating leverage in explaining overall business risk. In the regression with the CV of absolute earnings, the fixed asset turnover variable entered first. The coefficient was statistically significant but had the wrong sign. The second variable entered was the depreciation coverage variable and the coefficient was statistically significant and had the hypothesized sign. The third variable to enter the regression was absolute sales volatility. Its coefficient had the expected sign and was almost significant. Subsequent variables that entered made insignificant contributions and generally had the wrong signs. Notably the two operating leverage variables entered the regression before a sales volatility variable and both were statistically significant. The sign of the fixed asset turnover coefficient was not expected and an explanation is not apparent.

In the percent change earnings volatility regressions, the percent change sales volatility variable entered first, had the expected sign but

was not significant. Subsequently, the depreciation/sales ratio entered, had the expected sign but likewise was not statistically significant. This was followed by the D + R/sales variable with the wrong sign. The results were not consistent with the absolute earnings volatility results because the sales volatility variables entered first. A conclusion regarding the relative importance of operating leverage versus sales volatility would depend upon the preferred measure of business risk--i.e., should business risk be measured in terms of absolute earnings volatility or the volatility of percent changes in earnings?

In the multiple regressions with beta, the first variable to enter was the absolute earnings volatility variable and the coefficient was positive and significant. The second variable to enter was the depreciation plus rent coverage variable and it was also significant. The third variable to enter was the volatility of percent changes in earnings--it had the correct sign but was not significant. It is notable that these three variables accounted for over 73 percent of the variance in the beta coefficients.

Summary of Company Results

The description analysis of company operating leverage measures confirmed the results found for the industry variables. The six operating leverage measures had a wide range indicating different degrees of the use of fixed assets in operations. The earnings volatility measures (overall business risk) were greater than the sales volatility measures (primary business risk), indicating other factors influencing business risk. One was hypothesized to be operating leverage.

The correlation analysis generally confirmed the importance of the depreciation coverage measures as a measure of operating leverage. Other measures of operating leverage were less reliable or significant. Beta correlations with the operating leverage measures had mixed, and in some cases, unexpected results. The hypothesized relationship with depreciation coverage was confirmed and was statistically significant. The DOL results confirmed hypothesized problems with the conventional DOL measures, but also indicated the superiority of the depreciation coverage ratio as a measure of operating leverage.

The multiple regression results indicated that, in regard to the volatility of absolute earnings, the operating leverage variables were definitely more important than sales volatility. In the regressions with the volatility of percent changes in earnings, the sales volatility was more important but none of the coefficients were statistically significant. Finally, the beta regressions indicated the importance of total business risk but also pointed toward the additional importance of operating leverage.

Almost all the expected important relationships were confirmed, and there was continued support for the use of depreciation coverage as the best measure of operating leverage.

VI. SUMMARY, CONCLUSION AND IMPLICATIONS

Summary

Although operating leverage is an important concept in financial management it has received little attention. Therefore, the purpose of the study was to derive a clear specification of the concept, establish measures

that would be comparable to those employed in analyzing financial leverage, and empirically analyze the effect of operating leverage on the aggregate economy, alternative industries, and different companies.

A review of financial management texts indicated a fairly wide range of emphasis on the topic including six textbooks that ignored the concepts of operating leverage and breakeven analysis. Most texts that considered operating leverage discussed it in terms of breakeven analysis and typically measured it using the degree of operating leverage variable (DOL). It was noted that breakeven analysis and the DOL variables are not valid measures of operating leverage, but are indicators of the effect of operating leverage.

There was general agreement on the definition of operation leverage as fixed operating costs expressed as a percent of total operating costs. It was suggested that measures of operating leverage should conform to measures of financial leverage such as debt/total capital or times interest earned. The alternative available measures suggested for the economy and alternative industries were the depreciation/sales ratio, and times depreciation earned ratio. Because of data available, the company measures of operating leverage also included a fixed asset/total asset ratio, and a fixed asset turnover ratio.

The overall economic analysis indicated that operating leverage had consistently increased over time and that sales volatility had declined over time. The overall effect of these trends on earnings volatility depended upon the measure of earnings volatility used. The absolute earnings measures pointed toward a decrease in earnings volatility greater than the decrease in sales volatility. Part of the decline in earnings volatility was due

to a secular rise in the level of earnings because the percent change in earnings volatility measures increased in line with the increases in operating leverage. The employment of the conventional DOL variable as a measure of the effect of operating leverage caused problems because of what transpires when there are differences in signs between earnings changes and sales changes. Several alternative DOL variables were developed and they generally supported the expectations regarding the effect of operating leverage.

The industry analysis indicated a wide range in the level of operating leverage. The range of sales volatility measures also pointed toward a wide variance in primary business risk and there was evidence that industries considered their primary business risk when determining their level of operating leverage. Both the rank correlation and Pearson correlation results generated the expected relationship between the two measures of operating leverage and earnings volatility. The industry analysis confirmed the problems with the conventional DOLWS measure. The adjusted measures of DOL had the expected relationship with the depreciation coverage ratio. Finally, the multivariate regression analysis indicated the superiority of the operating leverage measures in explaining overall business risk compared to the sales volatility variables. The results of the multivariate analysis of industry betas were generally insignificant.

The analysis of different companies indicated substantial differences in operating leverage and sales volatility. Apparently companies consider their primary business risk when determining their relative amount of operating leverage. The correlation analysis indicated a strong relationship between the alternative measures of operating leverage, and the general

superiority of the depreciation coverage values. The company DOL comparisons with the operating leverage measures confirmed the prior results. While the conventional DOLWS ratio did not show the expected results the DOLWOS and DOL ABS DIF again had a strong relationship with the depreciation coverage measures of operating leverage. Beta, a company's measure of market determined risk, had the expected positive relationship with earnings volatility. The correlations between depreciation coverage and beta confirmed the importance of the depreciation coverage ratio as a measure of operating leverage and the effect of operating leverage on the firm's overall risk. Finally, the multivariate analysis of earnings volatility indicated that the fixed asset turnover variable was first to enter the regression but had an unexpected sign, followed by the depreciation coverage variable with the expected sign, and then the sales volatility variable. Again it appears that operating leverage was more important than sales volatility in explaining total business risk. The multivariate beta regressions likewise indicated the importance of operating leverage to a firm's systematic risk.

Conclusions and Implications

The analysis of a firm's risk has generally been divided into overall business risk and financial risk. The majority of our analysis has concentrated on business risk, wherein it is contended that there should be a breakdown of overall business risk into primary business risk and secondary business risk. Primary business risk is attributable to an economic unit's sales volatility which typically cannot be controlled by management. Secondary business risk is determined by how the economic unit chooses to produce its output in terms of the proportion of fixed costs to total

costs--i.e., how automated it chooses to become. This latter segment of business risk is generally referred to as operating leverage and has not been analyzed very extensively.

The analysis of operating leverage for the economy indicated that it had increased over time and might partially explain the relative increase in earnings volatility during a period when sales volatility has declined. The industry analysis showed a wide range of operating leverage, which indicates that the variable should receive increased attention because operating leverage was more important than sales volatility in explaining overall business risk. Also, subsequent analysis should concentrate on the use of the depreciation coverage ratio as the measure of industry operating leverage unless available data make it possible to expand the measures available.

The company analysis also indicated a wide range of operating leverage. Again, this would indicate a need for further analysis of the factor because there was a significant relationship between earnings volatility and/or market risk (Beta) and operating leverage. Also, the influence of operating leverage on the firm's overall business risk was more important than the influence of the sales volatility.

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TABLE I

MEASURES OF OPERATING LEVERAGE, SALES AND EARNINGS VOLATILITY
FOR THE S & P 425. AVERAGE OF FIVE YEAR INTERVALS, 1948-1972

Time Period	Deprec. \div Sales	ERDT \div Deprec.	CV Met Sales	CV Change in Sales	CV FBDT	CV Change in FBDT	CV FBT	CV Change in FBT	Average DOL	(W.S.) (WOS)	Abs. Diff. in Perc. Change
1948-52	2.728	5.514	.1384	1.052	.1749	2.034	.1863	2.505	1.42	2.13	15.92
1953-57	3.656	4.198	.0700	2.323	.1150	2.025	.1122	3.193	-0.14	1.93	6.55
1958-62	4.392	3.412	.0607	0.793	.0771	1.181	.0850	1.293	-3.14	6.36	7.39
1963-67	4.446	3.572	.1096	0.537	.1076	0.759	.0979	1.086	0.79	1.29	4.61
1968-72	4.572	3.176	.0855	0.769	.0751	1.786	.0899	2.856	3.63	3.65	7.45
Percent Change 48-52	+57.6	-42.4	-37.5	-26.9	-57.1	-12.2	-51.7	+14.0	+155.6	+71.4	-53.2

TABLE 2

DESCRIPTIVE STATISTICS FOR
72 STANDARD AND POOR'S INDUSTRIES

	MEAN	STD. DEV.	MIN.	MAX.	RANGE	SKENNESS	KURTOSIS
1. DEPREC./SALES	.039	.027	.009	.151	.142	1.852	3.925
2. EBDT/DEPREC.	3.940	1.616	1.260	9.375	8.115	.882	.775
3. C.V. Abs. SALES	.108	.042	.034	.297	.263	1.321	4.090
4. C.V. Abs. EARNs.	.200	.177	.038	.943	.905	2.189	5.249
5. C.V. PC SALES	1.476	3.312	-9.076	19.274	28.350	3.055	16.591
6. C.V. PC EARNs.	5.190	10.628	-3.525	83.531	87.055	5.706	38.293
7. DOLWS	.853	14.420	-79.930	38.280	118.210	-3.268	17.338
8. DOLWOS	8.768	17.758	.550	90.040	89.490	3.384	11.266
9. DOL-ABS. DIF.	.229	.266	.010	1.470	1.460	2.590	7.156
10. BETA	1.028	.254	.272	1.682	1.410	.185	.489

TABLE 3
PEARSON CORRELATIONS BETWEEN ALTERNATIVE
VARIABLES FOR 72 STANDARD AND POOR'S INDUSTRIES

	DEPREC./ SALES	EBDT/ DEPREC.	C.V. ABS. SALES	C.V. ABS. EARNS.	C.V. PC SALES	C.V. PC EARNS.	DOLWS	DOLWOS	DOL Abs. DIF.
1. DEPREC./SALES	-								
2. EBDT/DEPREC.	-.521*	-							
3. C.V. Abs. SALES	.194***	.132	-						
4. C.V. Abs. EARNS.	-.053	-.312**	-.117	-					
5. CV PC SALES	-.109	.203**	-.126	.124	-				
6. CV PC EARNS.	-.002	-.105	-.218**	.158***	.002	-			
7. DOLWS	.018	-.104	-.185***	.103	.055	.082	-		
8. DOLWOS	-.122	-.225**	-.018	.342**	.021	.159***	-.437*	-	
9. DOL-Abs. DIF.	.025	-.377*	.053	.816*	.114	.063	.083	.551*	-
10. BETA	.002	-.148	.069	.025	-.184***	.033	-.213**	.157***	.019

*Significant at .001

**Significant at .05

***Significant at .10

TABLE 4

SPEARMAN RANK ORDER CORRELATIONS BETWEEN ALTERNATIVE
VARIABLES FOR 72 STANDARD AND POOR'S INDUSTRIES

	DEPREC./ SALES	EBDT/ DEPREC.	C. V. Abs. SALES	C. V. Abs. EARNs.	C. V. PC SALES	C. V. PC EARNs.	DOLWS	DOLWOS	DOL Abs. DIF.
1. DEPREC./SALES	-								
2. EBDT/DEPREC.	.637*	-							
3. C.V. Abs. SALES	-.109	.265**	-						
4. C.V. Abs. EARNs.	.155	-.378*	-.098	-					
5. CV PC SALES	-.035	.068	-.237**	.254**	-				
6. CV PC EARNs.	.253**	-.298**	-.248**	.301**	.317**	-			
7. DOLWS	.037	-.066	-.280**	.358**	.390*	.206***	-		
8. DOLWOS	.127	-.450*	-.368*	.651*	.396*	.470*	.346**	-	
9. DOL-Abs. DIF.	.164	-.422*	-.020	.776*	.447*	.523*	.315**	.705*	-
10. BETA	.134	-.126	-.014	.143	.048	.083	-.001	.133	.075

* Significant at .001
** Significant at .05
*** Significant at .10

TABLE 5

MULTIPLE REGRESSION RESULTS OF BUSINESS RISK, ADJUSTED BETA,
 OPERATING LEVERAGE AND SALES VOLATILITY FOR INDUSTRIES
 IN STANDARD AND POOR'S SAMPLE

Expected Signs	(+)	(-)	(+)	(+)	(+)	(+)	(+)	(+)	R	S.E.
Constant	DEPREC./SALES	EBIT/DEPREC.	C.V. Abs./SALES	C.V. PC SALES	C.V. Abs./EBIT	C.V. PC EBIT				
C.V. Abs. EBIT	.476	(2) -1.938 (.838)	(1) -.055 (.014)	(3) .010 (.006)	C.V. FOR EBIT VARIABLES WERE NOT USED IN THE EBIT MULTIPLE REGRESSIONS				.444	.162
C.V. PC EBIT	12.772		(2) -.487 (.777)	(1) -52.783 (30.036)				.230	10.493	
BETA	1.192	(3) -1.03 (1.303)	(2) -.027 (.022)	(1) -.012 (.009)				.235	.252	

(Numbers in parentheses above coefficients indicate order or entrance)

(Numbers in parenthesis below coefficients are standard error of coefficient)

R = multiple regression coefficient

S.E. = standard error of estimate

TABLE 6

DESCRIPTIVE STATISTICS FOR 30 COMPANIES
IN DOW-JONES INDUSTRIAL AVERAGE

	MEAN	STD. DEV.	MIN.	MAX.	RANGE	SKEWNESS	KURTOSIS
1. FIXED ASSETS/T. ASSETS	.464	.166	.168	.864	.864	.034	-.436
2. SALES/FIXED ASSETS	3.116	2.232	.400	9.050	8.650	0.944	.027
3. DEPREC./SALES	.67	.030	.011	.149	.137	1.349	2.151
4. DEPREC. + RENT/SALES	.060	.033	.014	.156	.142	.945	.514
5. EBDT/DEPREC.	4.365	2.254	1.850	10.500	8.650	1.209	.662
6. EBDRT/D + R	3.491	1.624	1.660	7.720	6.060	1.234	.469
7. C.V. Abs. SALES	.113	.042	.028	.184	.156	-.153	-.916
8. C.V. Abs. EBIT	.216	.209	.041	.945	.904	2.379	4.712
9. C.V. PC SALES	1.296	2.938	-5.222	15.131	20.354	3.297	15.440
10. C.V. PC EBIT	3.094	5.254	-13.788	16.360	30.148	-0.054	3.380
11. DOL-WS	10.202	31.031	-6.310	160.630	166.940	3.892	15.575
12. DOL-WOS	13.658	30.758	.710	160.630	159.920	3.712	14.513
13. DOL-ABS. DIF.	.268	.507	.030	2.730	2.700	3.791	15.113
14. BETA (ADJUSTED)	.997	.185	.650	1.440	.790	.327	-.191

TABLE 7

SPEARMAN RANK ORDER CORRELATIONS BETWEEN ALTERNATIVE VARIABLES
FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

	R.A./ T.A.	SALES/ F.A.	DEPR./ SALES	D + R/ SALES	EBDT/ DEPR.	EBDT/ D + R	C.V. Abs.	C.V. Abs.	C.V. PC	C.V. PC	DOL WS	DOL IWS	DOL ABSDIF
1. FIXED ASSETS/TOTAL ASSETS	-												
2. SALES/FIXED ASSETS	-.900*	-											
3. DEPREC./SALES	.755*	-.838*	-										
4. DEPREC. + RENT/SALES	.718*	-.781*	.921*	-									
5. EBDT/DEPR.	-.342***	.223	-.537**	-.461**	-								
6. EBDT/D + R	-.224	.084	-.360***	-.456**	.880*	-							
7. C.V. Abs. SALES	-.062	-.103	-.173	-.047	.613*	.503**	-						
8. C.V. Abs. EARN.	.013	.021	.019	-.057	-.411**	-.333**	-.064	-					
9. C.V. PC SALES	.059	-.152	.168	.023	-.234	-.080	-.077	.437**	-				
10. C.V. PC EARN.	.284	-.309	.311***	.206	-.422**	-.290	-.166	.346**	.807*	-			
11. DOL WS	-.399***	.324	-.257	-.263	-.028	-.034	.266	.358***	.346***	.117	-		
12. DOL IWS	-.132	.185	.057	-.039	-.647*	-.571*	-.397**	.656*	.523**	.497**	.440**	-	
13. DOL ABSdif	.012	.069	.000	-.607*	-.533**	-.124	.750*	.451**	.505**	.334**	.778*	-	
14. ADJUSTED BETA	-.006	.042	.023	.061	-.518**	-.557*	-.201	.364**	.268	.366**	.241	.486**	.615*

* Significant at .001
** Significant at .05
*** Significant at .10

TABLE 7

SPEARMAN RANK ORDER CORRELATIONS BETWEEN ALTERNATIVE VARIABLES
FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

	R.A./ T.A.	SALES/ F.A.	DEPR./ SALES	D + R/ SALES	EBDT/ DEPR.	EBDRT/ D + R	C.V. Abs.	C.V. Abs.	C.V. PC	C.V. PC	DOL WS	DOL MOS	DOL ABSDIF
1. FIXED ASSETS/TOTAL ASSETS	-												
2. SALES/FIXED ASSETS	-.900*	-											
3. DEPREC./SALES	.755*	-.838*	-										
4. DEPREC. + RENT/SALES	.718*	-.781*	.921*	-									
5. EBDT/DEPR.	-.342***	.223	-.537**	-.461**	-								
6. EBDRT/D + R	-.224	.084	-.360***	-.456**	.880*	-							
7. C.V. Abs. SALES	-.062	-.103	-.173	-.047	.613*	.503**	-						
8. C.V. Abs. EARNNS.	.013	.021	.019	-.057	-.411**	-.333**	-.064	-					
9. C.V. PC SALES	.059	-.152	.168	.023	-.234	-.080	-.077	.437**	-				
10. C.V. PC EARNNS.	.284	-.309	.311***	.206	-.422**	-.290	-.166	.346**	.807*	-			
11. DOL WS	-.399***	.324	-.257	-.263	-.028	-.034	.266	.358***	.346***	.117	-		
12. DOL MOS	-.132	.185	.057	-.039	-.647*	-.571*	-.397**	.656*	.523**	.497**	.440**	-	
13. DOL ABSdif	.012	.059	.069	.000	-.607*	-.533**	-.124	.750*	.451**	.505**	.334**	.778*	-
14. ADJUSTED BETA	-.006	.042	.023	.061	-.518**	-.557*	-.201	.364**	.268	.366**	.241	.486**	.615*

* Significant at .001
** Significant at .05
*** Significant at .10

TABLE 8

PEARSON CORRELATIONS BETWEEN ALTERNATIVE VARIABLES
FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

	F.A./ T.A.	SALES/ F.A.	DEPR./ SALES	D + R/ SALES	EBDT/ DEPR.	EBDRT/ D + R	C.V. Abs.	C.V. Abs.	C.V. PC	C.V. PC	C.V. PC	DOL WOS	DOL WOS	DOL ABSDIF
1. FIXED ASSETS/TOTAL ASSETS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. SALES/FIXED ASSETS	-.821*	-	-	-	-	-	-	-	-	-	-	-	-	-
3. DEPREC./SALES	.762*	-.704*	-	-	-	-	-	-	-	-	-	-	-	-
4. DEPREC. + RENT/SALES	.745*	-.708*	.955*	-	-	-	-	-	-	-	-	-	-	-
5. EBDT/DEPREC.	-.417**	.250	-.490**	-.475**	-	-	-	-	-	-	-	-	-	-
6. EBDT/ D + R	-.262	.091	-.358***	-.437**	.900*	-	-	-	-	-	-	-	-	-
7. C.V. ABS. SALES	.066	.117	.15	.012	.406**	.336***	-	-	-	-	-	-	-	-
8. C.V. ABS. EARN.	.291	.312***	-.170	-.201	-.300	-.239	.017	-	-	-	-	-	-	-
9. C.V. PC SALES	.124	-.256	.020	-.011	-.009	.075	.232	.187	-	-	-	-	-	-
10. C.V. PC EARN.	.191	-.237	.190	.145	-.136	-.026	-.039	-.041	.250	-	-	-	-	-
11. DOL WS	-.402**	.473**	-.190	-.221	-.240	-.215	-.111	.739*	-.339***	-.090	-	-	-	-
12. DOL WOS	-.360**	-.471**	-.177	-.222	-.328***	-.294	-.257	.740*	-.323***	-.056	.972*	-	-	-
13. DOL ABSdif	-.277	.294	-.180	-.216	-.256	-.214	.095	.740*	.112	-.033	.420**	.410**	-	-
14. ADJUSTED BETA	-.093	.156	-.082	-.073	-.425**	-.472**	-.129	.611*	.087	.214	.453**	.475**	.607*	-

* Significant at .001

** Significant at .05

*** Significant at .10

TABLE 9

MULTIPLE REGRESSION RESULTS OF BUSINESS RISK, ADJUSTED BETA, OPERATING LEVERAGE
AND SALES VOLATILITY FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

Expected Signs	(+)	(-)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	R	S.E.
Constant	FA/ TA	SALES/ FA	DEPR/ SALES	D + R/ SALES	EBDT/ DEPR.	EBDRT/ D + R	C.V. ABS. SALES	C.V. PC SALES	C.V. ABS. EBIT	C.V. PC EBIT		
C.V. ABS. EBIT =	0.128	--	0.045 (0.016)	--	--	-0.050 (0.017)	--	1.465 (0.921)	--	NOT INCLUDED IN THE EBIT	.562	.182
C.V. PC EBIT =	1.564	--	--	86.915 (109.000)	-52.323 (99.179)	--	--	0.623 (0.333)	MULTIPLE REGRESSIONS	.326	5.245	
BETA (ADJUSTED)	1.008								(1)	(3)	.733	.133

(Numbers in parentheses above coefficients indicate order or entrance)
(Numbers in parentheses below coefficients are standard error of coefficient)

R = multiple regression coefficient

S.E. = standard error of estimate

TABLE 7
SPEARMAN RANK ORDER CORRELATIONS BETWEEN ALTERNATIVE VARIABLES
FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

	F.A./ T.A.	SALES/ P.A.	DEPR./ SALES	D + R/ SALES	EBDT/ DEPR.	EBDT/ D + R	C.V. Abs.	C.V. Abs.	C.V. PC	C.V. PC	DOL MS	DOL WOS	DOL ADSLF
1. FIXED ASSETS/TOTAL ASSETS	- .900*	-											
2. SALES/FIXED ASSETS	- .755*	- .838*	-										
3. DEPREC. /SALES	.718**	- .781*	.921*	-									
4. DEPREC. + RENT/SALES	- .342***	.223	- .537***	- .461**	-								
5. EBDT/DEPR.	- .224	.084	- .360***	- .456**	.880*	-							
6. EBDT/D + R	- .062	-.103	- .173	- .047	.613*	.503**	-						
7. C.V. Abs. SALES	.013	.021	.019	-.057	-.411**	-.333**	-.064	-					
8. C.V. Abs. EARN.	.059	-.152	.168	.023	-.234	-.080	-.077	.437**	-				
9. C.V. PC SALES	.284	-.309	.311***	.206	-.422**	-.290	-.166	.346**	.807*	-			
10. C.V. PC EARN.	-.399**	.324	-.257	-.263	-.028	-.034	.266	.358***	.346***	.117	-		
11. DOL NS	-.132	.185	.057	-.039	-.647*	-.571*	-.397**	.656*	.523**	.497**	.440**	-	
12. DOL WOS	.012	.069	.069	.000	-.607*	-.533**	-.124	.750*	.451**	.505**	.334**	.778*	-
13. DOL ASDIF	-.006	.042	.023	.061	-.518**	-.557*	-.201	.364**	.268	.366**	.261	.486**	.615*
14. ADJUSTED BETA													

* Significant at .001
** Significant at .05
*** Significant at .10

TABLE 8

PEARSON CORRELATIONS BETWEEN ALTERNATIVE VARIABLES
FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

	F.A./ T.A.	SALES / F.A.	DEPR. / SALES	D + R/ SALES	EBDT / DEPR.	EBDT / D + R	C.V. Abs.	C.V. Abs.	C.V. PC	C.V. PC	DOL RS	DOL MOS	DOL ABSDIT
1. FIXED ASSETS/TOTAL ASSETS	-												
2. SALES/FIXED ASSETS	-.821*	-											
3. DEPREC./SALES	.762*	-.704*	-										
4. DEPREC. + RENT/SALES	.745*	-.708*	.955*	-									
5. EBDT/DEPREC.	.417**	.250	-.490**	-.475**	-								
6. EBDT/ D + R	-.262	.091	-.358***	-.437**	.900*	-							
7. C.V. Abs. SALES	-.066	-.117	-.125	-.012	.406**	.336***	-						
8. C.V. Abs. EARN.	-.291	.312***	-.170	-.201	-.300	-.239	.017	-					
9. C.V. PC SALES	.126	-.256	.020	-.011	.009	.075	.232	.187	-				
10. C.V. PC EARN.	.191	-.237	.190	.145	-.136	-.026	-.039	-.061	.250	-			
11. DOL RS	-.402**	.473**	-.190	-.221	-.240	-.215	.111	.739*	-.339***	-.090	-		
12. DOL MOS	-.360***	-.671**	-.177	-.222	-.328***	-.294	-.257	.740*	-.323***	-.056	.972*	-	
13. DOL ABSDF	-.277	.294	-.180	-.216	-.256	-.214	.095	.740*	.112	-.033	.420**	.410**	-
14. ADJUSTED BETA	-.093	.156	-.082	-.073	-.425**	-.472**	-.129	.611*	.087	.214	.453**	.475**	.607*

* Significant at .001

** Significant at .05

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TABLE 9

MULTIPLE REGRESSION RESULTS OF BUSINESS RISK, ADJUSTED BETA, OPERATING LEVERAGE
AND SALES VOLATILITY FOR COMPANIES IN DOW JONES INDUSTRIAL AVERAGE

Expected Signs	(+)	(-)	(+)	(+)	(-)	(-)	(+)	(+)	(+)	(+)	R	S.E.
Constant	FA/ TA	SALES/ FA	EBIT/ SALES	D + R/ SALES	EBIT/ DEPR.	EBIT/ D + R	C.V. ABS. SALES	C.V. PC SALES	C.V. ABS. EBIT	C.V. PC EBIT		
C.V. ABS. EBIT =	0.128	--	0.045 (0.016)	--	--	-0.050 (0.017)	--	1.465 (0.921)	--	.562	.182	
C.V. PC EBIT =	1.564	--	--	86.915 (109.000)	-52.323 (99.179)	--	--	--	0.423 (0.333)	.326	5.245	
BETA (ADJUSTED)	1.003								(5)	(3)		
									.479 (.122)	.008 (.005)	.733	.133

(Numbers in parentheses above coefficients indicate order of entrance)

(Numbers in parentheses below coefficients are standard error of coefficient)

R = multiple regression coefficient

S.E. = standard error of estimate



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